THE UNIVERSITY
OF ILLINOIS
LIBRARY
630.7
I f 6b
no. 377-89
cop. 2

NOTICE: Return or renew all Library Materials! The *Minimum* Fee for each Lost Book is $50.00.

The person charging this material is responsible for its return to the library from which it was withdrawn on or before the **Latest Date** stamped below.

Theft, mutilation, and underlining of books are reasons for disciplinary action and may result in dismissal from the University.
To renew call Telephone Center, 333-8400

UNIVERSITY OF ILLINOIS LIBRARY AT URBANA-CHAMPAIGN

SEP 24 1995

SEP 26 1995

JAN 15 1997

JAN 28 2000

FEB 03 2000

L161—O-1096

Causes of Damage to Fruits and Vegetables During Shipment

By J. W. Lloyd and H. M. Newell

UNIVERSITY OF ILLINOIS
AGRICULTURAL EXPERIMENT STATION
BULLETIN 379

CONTENTS

PAGE

SHIFT OF LOAD CHIEF CAUSE OF DAMAGE 84
- Bushel Baskets and Tubs Too Loosely Loaded 85
- Half-Bushel Baskets and Tubs Hard to Stow Compactly 89
- Hampers Not Properly Alternated 91
- Inadequate Stripping Caused Damage to Crated Vegetables 93
- Crated Melons Need Secure Center Bracing 94
- Tomatoes in Lugs Suffer From Lack of Center Bracing 95
- Menace of Partial Top Layer 99
- Mixed Load Increases Risk 102
- Rough Handling May Cause Shift in Best of Loads 103

HANDLING A DISARRANGED LOAD TO PREVENT FURTHER DAMAGE 106

PRECAUTIONS TO PREVENT DAMAGE BY SHIFTING OF LOAD. 107
- End-to-End Offset Load for Baskets 107
- Alternating Hampers 109
- Hooks on Baskets 109
- Use of Pads in Baskets 110
- Careful Stripping of Rectangular Packages 110
- Adequate Center Bracing 112
- Use of Well-Made, Rigid Containers 114
- Demonstrations in Proper Loading 115
- Careful Handling of Car 115

OTHER PRECAUTIONS TO REDUCE DETERIORATION IN TRANSIT 116
- Prompt Movement of Perishables 116
- Elimination of Poor Shipping Varieties 117
- Consistent Use of Refrigeration 117

SUMMARY AND CONCLUSIONS 118

Urbana, Illinois June, 1932

Publications in the Bulletin series report the results of investigations made by or sponsored by the Experiment Station

Causes of Damage to Fruits and Vegetables During Shipment

By J. W. Lloyd, Chief in Fruit and Vegetable Marketing, and H. M. Newell, Associate

MORE THAN one million carloads of fruits and vegetables were shipped by rail in the United States during 1930. It has been reported[1] that the loss on these shipments attributed to deterioration and damage in transit amounted to an average of $11.25 a car, or a loss of $11,250,000 on the season's shipments of these products. If such losses could be cut in half, it would mean a saving of more than 5½ million dollars a year, based on the volume of shipments for the year in question.

Before a beginning can be made toward reducing such losses it is important that the nature and causes of the damage be determined.

In order to secure first-hand information regarding the condition of carloads of perishable fruits and vegetables arriving in terminal markets, the authors spent the month of July, 1931, at the Chicago Produce Terminal making observations on carloads of these products being unloaded at the team tracks or being inspected in the "hold yard" adjoining. Special attention was given to "bad-order" cars, tho other cars also were observed for comparison. Notes were recorded on 249 cars. Thru the courtesy of the Perishable Freight Department of the Illinois Central Railway, the general superintendent of the Chicago Produce Terminal and representatives of the various bureaus and companies carrying on inspection service at the terminal, ready access was gained to any car on the tracks. The hearty cooperation of all officials and employees with whom contacts were made added much to the thoroness with which it was possible to do the work.

In some instances the "bad order" of commodities in a car consisted of overripeness or decay. Records of shipping and arrival dates indicated that in some of these cases altho the car had moved from the producing region to the market terminal in normal time, it had been held on track for several days (presumably on owner's orders) before unloading commenced. In other cases considerable decay was apparent (in peaches and summer apples) even tho the goods had been in transit only a few days and were unloaded promptly on arrival. In such instances the fruit may have been too ripe when picked, held too long after picking before being placed under refrigeration, handled roughly

[1]Freight Claim Prevention Bul. 371, American Railway Association, April 7, 1931.

during the harvesting process,[1] or gathered from an orchard where rot infection was abundant. No data were available regarding the handling of the commodity prior to the billing out of the car; hence this phase of the subject could not be traced in reference to the cars in question.

SHIFT OF LOAD CHIEF CAUSE OF DAMAGE

Altho some carloads of perishables were designated as in "bad order" because of decay, by far the greater number of "bad-order" cars were designated as such because of a shifting of the load. The shift in the load varied all the way from a few inches to a few feet, and was accompanied by damage varying from a few loose covers or slats to an apparent wreck of the entire load. A detailed study was made of shifted loads in an attempt to determine so far as possible the cause of the shift in each car as well as the extent of the damage. It was hoped that a study of the data thus secured would bring out suggestions regarding methods of loading or handling that might be a means of reducing this sort of damage.

Two general types of packages are used in shipping the more perishable fruits and vegetables that come to the Chicago market during the summer months. These include circular stave baskets, tubs, and hampers and various sizes of rectangular crates and boxes. Several different commodities are shipped in the same type of package. At the Chicago Produce Terminal in July, 1931, the following commodities were observed in bushel baskets and tub bushels: apples, peaches, pears, cucumbers, green corn, green peppers, and sweet potatoes. Bushel hampers had been used for the shipping of string beans, cucumbers, eggplant, green peppers, and sweet potatoes. Slatted crates in various sizes had been used as shipping containers for cabbage, cantaloupes, cauliflower, green corn, Honey Ball melons, Honey Dew melons, lettuce, spinach, and peaches. Western apples and pears had been shipped in boxes and tomatoes in lug boxes.[2]

The method of loading baskets and hampers is entirely different from the loading of crates and boxes. Baskets and hampers are normally loaded without any strips or braces, while the approved method of loading crates and boxes of many perishables involves the use of strips between the layers of packages and heavy braces at the center of the car. The baskets and hampers are supposed to be loaded suffi-

[1]For a discussion of the relation of rough handling during harvest and delayed loading to the keeping quality of fruit, see Bulletin 350 of this Station, "Some Factors Influencing the Keeping Quality of Fruit in Transit."

[2]In this study little attention was given to commodities shipped in sacks, such as potatoes and onions.

ciently solid to hold one another in place, while the strips and braces are depended on to keep the crates and boxes properly spaced. Crates and boxes are usually loaded with spaces between the rows of packages to facilitate air circulation thru the load.

Bushel Baskets and Tubs Too Loosely Loaded

The approved method of loading round-bottom bushel baskets and straight-sided tub bushels is the end-to-end offset load lengthwise of the car. Refrigerator cars of different railroad lines vary somewhat in inside dimensions, but standard dimensions of the cars of certain lines are 33 feet 5 inches long and 8 feet 2 inches wide. Many other cars differ but slightly from these dimensions.

In all cars of approximately the above dimensions the normal load is 22 baskets long and 6 wide. Peaches are normally loaded 3 baskets high, making 396 bushels to the car, and apples 4 baskets high, making 528 bushels to the car. Cucumbers are loaded either 3 or 4 baskets high. Careful loading is necessary from the start in order to come out even and have enough space for the last two rows of baskets in finishing the load. A frequent cause of disarranged and damaged loads is failure to put in a sufficient number of baskets to make a compact load, even tho the end-to-end method of loading is used. When the crosswise method of loading is employed, particularly when no offset is used, the resulting load is very loose and subject to much shifting and damage.

Of the 55 cars of peaches, summer apples, and cucumbers in bushel baskets or tub bushels in which a shift of the load was noted, the shifting and attendant damage in 32 cars were directly associated with loose loading. Some examples may be cited, as follows:

Car 1 (peaches in round-bottom bushel baskets) was loaded only 21 baskets long, making a total of 378 baskets instead of the normal load of 396 baskets. This load showed a 1- to 2-foot shift away from one end of the car, with 9 baskets wrenched, several covers off, and part of the contents spilled on the floor.

Car 2, loaded with tub bushels of peaches 21 long, showed a 10- to 12-inch shift in three rows at one end; 3 baskets were tilted on their sides, 3 had been jammed, and 1 had collapsed.

Car 3, loaded with 387 tub bushels of peaches, showed a 12-inch shift at one end and a 4-inch shift at the other end; several baskets had dropped down; 3 were crushed; and several others had loose covers. When the unloading of this car was completed, 17 packages were reported as having faces broken.

Car 4 (peaches in tub bushels) showed a 1- to 5-foot shift in the two top layers at one end of the car; several baskets had lids off and contents spilling (see picture on front cover). A few visible baskets were

crushed. The final report on this car showed "51 baskets wrenched, faces broken, part of contents bruised; 4 baskets exchanged, part contents picked off floor; 2 empty baskets left in car." Altho this car was 33 feet 2¾ inches long and should have been loaded 22 baskets long, it was loaded 21 and 22 long, a total of 387 instead of 396 baskets, making a loose load.

FIG. 1.—PROPERLY AND IMPROPERLY LOADED BUSHEL CONTAINERS OF PEACHES

Loaded according to the end-to-end offset method, 3 high, 6 wide, and 22 long, Car 6 arrived at the terminal in perfect condition. Car 5 was loaded crosswise, with packages placed only 5 wide across the car.

Car 5 was loaded with bushel containers of peaches according to the cross offset method of loading. The packages were placed only 5 wide across the car, the result being a loose load which became disarranged during shipment. In the top layer there were 8 baskets with covers off and contents spilling. Many other packages were tilted. A view of the doorway is shown in Fig. 1.

Contrasted with these cars of peaches is Car 6, which arrived in perfect condition (Fig. 1).

Car 7, loaded with apples in round-bottom bushel baskets, showed a 1-foot shift in the top layer at one end. Altho the load was evidently started as a regular end-to-end offset load 22 baskets long, there was evidence of rather loose, poor loading at the doorway, some baskets resting directly on those below, and the total number of baskets in the car was only 523 instead of the regular 528. A few baskets were tilted and wrenched.

Car 8, loaded with Transparent apples in bushel containers, showed a 12- to 18-inch shift in the two top layers at both ends of the car. This car had been loaded only 21 baskets long instead of 22, and there was slack space at the center. A view in the doorway after unloading had commenced is shown in Fig. 2.

FIG. 2.—SLACK SPACE, WRENCHED BASKETS, AND SPILLED CONTENTS ATTEST THE BAD RESULTS OF LOOSE LOADING

These baskets of apples were loaded 21 packages long instead of 22. Picture was taken after unloading had commenced. (Car 8)

Several cars of cucumbers in bushel baskets or tub bushels showed especially faulty loading. The conditions in four of these cars were as follows:

Car 9 was loaded crosswise the car, 5 wide; the packages were loosely stowed and not properly staggered. There was a 6-inch to 2-foot shift from one end of the car toward the doorway; the baskets were

FIG. 3.—CUCUMBERS IN TUB BUSHELS LOADED WITH NO OFFSET

Loaded 5 wide with no offset, many covers were off and contents spilling. (Car 10)

badly tilted thruout that end of the car. One basket was crushed and its contents spilled into the bunker; various other baskets had the covers loose and part of the contents spilled. There were about 2 bushels of cucumbers scattered over the car floor.

Car 10, loaded with cucumbers in tub bushels, showed a 5-foot shift in the top layer at one end and a 6-inch to 5-foot shift in the top layer at the other end. Several packages had the covers off (Fig. 3). Many baskets in the bottom layers near the doorway were wrenched and crushed (Fig. 4). In salvaging this load 42 new containers were used.

FIG. 4.—A VIEW IN THE DOORWAY OF CAR 10

In the lower layer many packages were wrenched and crushed. Picture was taken after one end of the car had been unloaded.

This was supposedly an end-to-end load 5 wide, but it had no offset. Loose loading was apparently the primary cause of the trouble. There were gaps several inches wide between baskets.

Car 11, loaded with cucumbers in round-bottom bushel baskets, was badly shifted on one side owing to the omission of one row of baskets. The car was loaded 4 high and 5 wide end-to-end but with no offset. There were only 400 bushels in the car, thus making a very loose load. Many packages were overturned and disarranged; several were broken and the contents spilling.

Car 12 showed a 1- to 2-foot shift in the three top layers from each bunker toward the center, and also a 6-inch to 1-foot shift sidewise. About 25 percent of the baskets were partially crushed. This was an

offset cross load, 5 wide, containing only 414 bushel baskets of cucumbers. The loading was entirely too loose.

Half-Bushel Baskets and Tubs Hard to Stow Compactly

Many carloads of peaches, particularly from Georgia, arrived on the Chicago market packed in half-bushel, round-bottom baskets or half-bushel tubs.

The loading of these packages seemed to present special difficulties, and several methods of loading had been attempted. The most common method of loading seemed to be crosswise of the car, 6 and 7 baskets wide, offset. In a few instances the crosswise load was only 6 baskets wide. The end-to-end offset load was also used, in some cases the load being 7 wide and in other cases 7 and 8 wide. In the latter method of loading, six rows were loaded end to end in the regular way, and then there was too much space left for one row and too little space for two rows. The baskets in the last two rows were zigzagged to fill this space as completely as possible, but the result was a rather defective load. In nearly every case the load was 4 baskets high. A normal load seemed to be 780 packages. Description of the condition of the contents of some of these cars follows:

Car 13, loaded crosswise with half-bushel, round-bottom baskets of peaches 6 and 7 wide, showed a shift of only 2 to 6 inches at one end, yet so many baskets in the bottom layer were crushed that 55 packages had to be exchanged in salvaging the load.

Car 14, loaded in the same way as the preceding car, showed only a slight shift at each end, yet several baskets near each bunker were badly tilted. Very little damage was apparent, but the load was in condition to receive considerable damage if it had been bumped in switching.

Car 15 showed a 4-foot shift from the east end toward the center (Fig. 5). Several baskets were crushed and the contents spilling; many more were disarranged and tilted. The final report on this car showed "50 baskets wrenched—15 percent of same with broken faces; 9 new baskets used to replace broken ones." This also was a cross load 6 and 7 wide.

Car 16 showed a 6-inch to 3-foot shift from the west end in the two top layers. Seven baskets were spilling at the west bunker; 10 baskets were spilling and 4 were jammed at the east bunker; and baskets along the north wall were disarranged, 4 spilling and 15 tilted (Fig. 5). This was an end-to-end offset load, 7 and 8 wide, loosely stowed. Seven empty baskets were left in this car when unloading was completed, and 15 baskets were delivered with faces broken.

Car 17, loaded with peaches in half-bushel tubs, showed a 6-inch to 2-foot shift from the east bunker in the two top layers; also packages were disarranged in two rows of the top layer along the north wall (Fig. 5). Six baskets at the east bunker were spilling, 4 baskets at the west bunker were jammed, and a few covers were loose. This was an

FIG. 5.—THE RESULTS OF LOOSE LOADING OF HALF-BUSHEL CONTAINERS OF PEACHES

A 4-foot shift occurred from the end of Car 15, which was loaded crosswise. Several baskets were crushed and the contents spilling; many more were disarranged and tilted.

The first six rows in Car 16 had been loaded by the end-to-end offset method; the last two rows along one side of the car had been loaded loosely, with break joints. Baskets along this side of the car were badly disarranged.

The view across the end of Car 17, loaded the same as Car 16, shows shift of load away from bunker.

end-to-end offset load, 7 and 8 wide. The last two rows loaded were zigzagged, making an insecure load.

The dimensions of the half-bushel basket or tub make these packages difficult to load securely in a refrigerator car of the usual width. A very slight reduction in the diameter of these packages, with a corresponding increase in height so that the cubic contents would be

FIG. 6.—A PERFECT LOAD OF PEACHES IN HALF-BUSHEL TUBS
Wider than most cars, this car gave sufficient space for a solid end-to-end offset load 8 rows wide. (Car 18)

the same, would make it possible to build a compact load by the end-to-end offset method, 8 baskets wide. Such a change would overcome the chief disadvantage of this type of package as a shipping container for peaches. The present package does not lend itself readily to secure loading. One load of these half-bushel packages was in an extra wide car (No. 18, 8 feet 4⅝ inches wide) and rode in perfect condition (Fig. 6). It was an end-to-end offset load, 8 baskets wide.

Hampers Not Properly Alternated

Green peppers constituted the principal product arriving at the Chicago Produce Terminal in bushel hampers during July, 1931, tho eggplant, cucumbers, carrots, string beans, and sweet potatoes were also received in bushel hampers. These packages containing light material, such as peppers or string beans, are normally loaded 4 high and 7 wide in a refrigerator car. To make a solid load, packages placed upside down alternate with those right side up (Car 19, Fig. 7). Failure to carry out this arrangement systematically results in a less secure load and consequently greater risk of damage. Also a load in which hampers are placed 3 high on end and then surmounted by a layer (of hampers) on their sides, is less likely to ride securely than the regular 4-high load.

Faulty loading was observed in the following three carloads of products packed in hampers.

Car 20 (bushel hampers of peppers and a few hampers of eggplant) had one end loaded with all hampers upside down, tho in the other end the hampers were alternated in the approved manner. The improper loading resulted in a tilting of the hampers toward the door in that end of the car. The covers of many of the hampers that were upside down

had become loose, and the contents were spilled when the packages were picked up for unloading.

Car 21, loaded with bushel hampers of peppers and carrots, showed an irregular shift thruout the load. Five visible hampers were broken, 3 were spilling, and 3 others had covers off. The shift was probably due to improper stowing of the hampers; three rows along the south wall of the car were loaded with heads down, instead of alternating.

FIG. 7.—WELL-LOADED AND BADLY LOADED HAMPERS

Car 19 consisted of hampers of peppers loaded 4 high and 7 wide and consistently alternated right side up and upside down; these came thru in good shape. In Car 22, loaded with string beans, two layers of hampers were placed on end, surmounted by a layer on their sides thru part of the car and two layers on their sides the rest of the way.

Car 22, loaded with bushel hampers of string beans, showed a slight shift thruout the load and a badly disarranged doorway (Fig. 7). Three visible hampers had the covers loose and part of their contents spilling. Hampers in the bottom layer at the doorway had been caught in the floor rack and wrenched out of shape. The bad condition of this car was due largely to faulty loading; two layers of hampers were loaded on end, surmounted by one layer on their sides thru part of the car and two layers on their sides the rest of the way.

Inadequate Stripping Caused Damage to Crated Vegetables

Slatted crates containing lettuce, cauliflower, spinach, and green corn shipped in carlots to the Chicago market during July, 1931, were usually loaded with strips between the layers but with no bracing at the center of the car. All loads of these commodities were top-iced. The lettuce and spinach were packed with crushed ice in the package. A few cars of cauliflower were loaded with "pigeon-hole" icing (Car 23, Fig. 8). Six-basket carriers of peaches were loaded with strips between the layers; some cars had center bracing and some had not.

FIG. 8.—CAULIFLOWER IN CRATES, WITH TOP-ICING AND "PIGEON-HOLE" ICING

The usual method of loading western cauliflower and western lettuce includes top-icing; "pigeon-hole" icing is less common. (Car 23)

Cars loaded with cantaloupes, Honey Dew melons, or Honey Ball melons invariably had strips between the layers of crates and also bracing at the center of the car.

Cars of western lettuce and southern green corn were usually loaded so solid that there was little chance for end shift, and the stripping ordinarily prevented any side shift. Only very rough handling would result in damage to such cars. One car of eastern lettuce (No. 24) showed a side shift of 4 to 8 inches, closing part of the air channels. This car had been loaded break joint, 4 and 5 crates wide alternating, with 4- to 8-inch spaces between crates. The load was 7 crates high, with strips on the top layer only. There was no center bracing. The shift in this load was plainly due to lack of proper stripping.

In a car of western spinach (No. 25) the crates at both ends of the car had shifted off the strips, and the large cakes of ice on top had

caved in the lids of practically all the crates in the top layer. The caving-in was probably due partly to slackness in the crates, and partly to the fact that the crates were loaded flat instead of being loaded with the bulge on the side, as western lettuce in similar crates is usually loaded.

Crated Melons Need Secure Center Bracing

Defective center bracing was apparent in most of the bad-order cars of cantaloupes and other melons observed.

FIG. 9.—COLLAPSE OF CENTER BRACING IN CAR OF CANTALOUPES
The center bracing was made of brittle lumber and was not properly constructed. (Car 26)

In Car *26*, loaded with jumbo crates of cantaloupes 3 high and 6 wide, the center bracing had completely collapsed and crates in the second and third layers had shifted 2 to 10 inches toward the bracing (Fig. 9). Several crates were broken and the contents spilling. Examination showed that the lumber (2-by-4's) used in constructing the braces was very brittle and that the braces were not properly made.

In Car *27*, loaded with standard crates of cantaloupes, the center bracing had collapsed and allowed the load to shift toward the center of the car. The heads of 5 crates in the top layer were broken; 12 other visible crates had broken slats and the melons were spilling out. Each gate in the center bracing had been made with 4 knotty pine 2-by-4-inch uprights. All these uprights were broken.

The center bracing had also collapsed in Car 28 loaded with standard crates of cantaloupes, 3 high and 7 wide. Three of the four uprights in one gate were broken and one of the top crossbars was broken into six pieces. The ends of 4 crates in the top layer were crushed in opposite to the 4 uprights in the bracing. The two top layers of crates had shifted 8 inches away from the east end of the car at the north corner; many crates were wrenched. The collapse of the bracing was due partly to brashy lumber and faulty construction. Each gate was made of four 2-by-4 uprights opposite the centers of alternate rows of crates, and three 1-by-4 crossbars next to the crates and opposite the centers of the crates in each layer. There were only two sets of short 2-by-4 spreaders to hold the gates apart. These were placed opposite the centers of the top and bottom layers of crates.

In Car 29 the bracing had broken at knots in the 2-by-4 uprights, allowing a 2- to 6-inch shift in the top layer toward the center of the car. Twenty-six crates were broken; in 6 of these the melons had to be repacked.

While the lumber used in the center bracing of these cars of cantaloupes was defective and the construction of the braces was in some cases faulty, it is probable that at least part of the breakage may have been due to rough handling of the cars. With careful handling the defective bracing might have held.

The cars loaded with Honey Dew melons showed equally severe damage.

Car 30, loaded with Honey Dew melons, 5 crates wide and 6 high, had center bracing in which the top spreaders were longer than the bottom spreaders. This allowed an end shift especially at the bottom of the load. Slats on many crates were loose, necessitating the renailing of 75 packages.

In Car 31, also loaded with Honey Dew melons in flats, the bracing was intact but so loose that it did not take up all the slack in the load. Sixteen crates were broken, with side slats loose and cover slats buckled; the contents of 5 visible crates were spilling.

Tomatoes in Lugs Suffer From Lack of Center Bracing

Most of the tomatoes arriving on the Chicago market in carload lots during July, 1931, were packed in lug boxes containing approximately 30 pounds each. The normal method of loading cars with these packages was 5 high, 6 wide, and either 20 or 21 long, with bracing at the center of the car and strips between all layers.

Most of the cars of tomatoes originating in Tennessee were especially well braced, seasoned oak lumber having been used. Each gate usually consisted of six 1-by-4 uprights (one against each row of lugs) and three 2-by-4 horizontal pieces. The two gates were braced apart by three sets of 2-by-4-inch cross spreaders, the bottom set resting on the floor rack, the second set opposite the third layer of lug boxes,

and the third set opposite the top layer of lugs. In some cases the uprights as well as the horizontal pieces were 2-by-4's. The second and fifth uprights extended to the top of the car. In the numerous cars examined none of the oak bracing constructed in this manner had been broken or displaced. Any shifting of tomato loads with

FIG. 10.—IMPROPERLY BRACED TOMATO LOADS

The shift in Car 32 was due to inadequate stripping and lack of center bracing. In Car 33 inadequate bracing permitted the load to shift from both ends toward the center. Practically all the boxes were off the strips, giving a "sawtooth" effect to the load. Several lugs were crushed and leaking.

such bracing was usually slight—not more than 1 or 2 inches. In such a shift some of the lugs were sometimes shoved off the strips supporting them. This occurred principally where very narrow strips had been used. Only when the car had evidently been very severely bumped was there any serious disarrangement of the load, and even then the bracing held.

Contrasted with the method of loading tomatoes, above described, were various methods employed in several cars shipped from eastern

states. In none of these cars was there any substantial bracing at the center of the load.

In Car 32, 1-by-1-inch strips had been placed between all layers at the doorway, but only on the top layer thru the rest of the load. There was a space 7 inches wide between stacks at the doorway; 1-by-1-inch strips had been nailed to the car floor to keep the lugs in the bottom layer from sliding across this space. The same size strips 3 feet long had been nailed to the top layer of lugs in the doorway, evidently with the hope that they would brace the load. The little strips had been

FIG. 11.—UNUSUAL METHOD OF LOADING TOMATOES

Loaded edgewise instead of flat, the pack seemed slack, the tomatoes having settled to the lower side of each lug. Many lugs had to be recoopered and renailed. (Car 35)

broken, however, and the two stacks of lugs at the center of the car had shifted together (Fig. 10). There was also considerable side shift in the car owing to lack of proper stripping.

Car 33 had no pretense at center bracing except 6 little strips nailed to the top lugs. These had failed to hold. The load had shifted from both ends toward the center of the car, resulting in the crushing of several lugs (Fig. 10). Practically all lugs had shifted off the strips, giving a "saw-tooth" effect to the load (Fig. 10). Several lugs were leaking.

In Car 34, ¾-by-¾-inch stripping had been used thruout the load, but only the strips on the top layer had been nailed. The only bracing consisted of 5 pieces of stripping material nailed lengthwise across the two middle stacks in the top layer. Stripping had also been placed lengthwise on the lower layers but had not been nailed. The load had shifted from both ends toward the center of the car. All layers of lugs were off the strips, so that all packages above the bottom layer were resting with one end on the crate below.

In Car 35 the tomato lugs were loaded edgewise instead of flat (Fig. 11). Strips ¾-by-¾-inch had been placed lengthwise between all layers in the doorway. Stripping across the car was used only on the top layer. There was a slight shift in several stacks thruout the load. The pack seemed slack because the tomatoes had settled to the lower side of the lugs. In unloading this car, 20 lugs had to be recoopered and 35 renailed.

Car 36 had no center bracing except 12 little strips nailed on the top layer of lugs across the doorway. There was a slight end shift on both sides of the doorway that let several lugs drop off the strips. There were two broken crates in the doorway (Fig. 12). This car had been loaded lengthwise 4 high and 7 wide, except at the doorway, where the lugs were placed on edge.

FIG. 12.—FAULTY LOADING AT DOORWAY

These lugs of tomatoes were loaded flat except at the doorway. There was no adequate bracing, however, and a slight end shift in the load resulted in several lugs dropping off the strips. (Car 36)

Car 37 had merely strips for center bracing extending across two stacks in the top layer. There was a 10-inch shift of the load from the east bunker toward the door. At both ends of the car the lugs had shifted entirely off the strips. Apparently all lugs in the bottom layer were crushed and jammed, with contents mashed and leaking (Fig. 13). All other layers except the top showed bruising of the tomatoes in nearly every lug.

Car 38 was loaded 5 high and 5 wide crosswise instead of lengthwise of the car. Strips ¾-by-¾-inch nailed lengthwise on top of the two middle stacks of the top layer constituted the only center bracing. Strips of the same dimensions were nailed crosswise on the top layer thruout the load. There were no strips on any of the other layers except on the two middle stacks. The east end of the car showed a shift of 8 to 12 inches from the bunker toward the doorway. The packages were much disarranged and had fallen down in at least three layers and three stacks. The west end of the load was slightly jammed. At the center of the car 12 lugs were disarranged and broken and the contents of most

FIG. 13.—FURTHER EXAMPLES OF IMPROPER CENTER BRACING

This picture of Car 37, loaded with tomatoes, was taken after the car was partially unloaded. At both ends of this car the lugs had shifted entirely off the strips. In the bottom layer the lugs were crushed and jammed, with contents mashed and leaking. Many packages in Car 38 were disarranged and broken.

of them were spilling (Fig. 13). When this car was unloaded, 20 lugs were recoopered, 90 renailed, and 4 repacked.

Menace of Partial Top Layer

Sometimes the quantity of a given commodity available for shipping at a given time does not make even carloads. This is especially likely to be the situation at the beginning and end of the shipping season or at shipping points where the total production is not heavy. Such a situation often seems to necessitate the loading of a car with less or with more than the usual amount of the given commodity, and the result is a load with a partial top layer of packages. Such a partial layer always introduces an additional hazard. In spite of various methods employed in attempts to make such a partial layer secure, the risk of damage to the load is greatly increased by its presence.

In the loading of bushel baskets the method usually employed is to place the partial layer at one end of the car, offsetting the packages the same as in the other layers and finishing the end of the partial layer with one or two rows of baskets turned upside down. Placed thus the baskets have less tendency to rock and roll, and they assist in holding the rest of the partial layer in place. Any severe jolting of the car, however, is likely to badly disarrange the partial layer. In attempts to overcome this difficulty, braces are sometimes introduced in carloads of baskets. Such braces are likely to fail to accomplish their purpose.

However, in Car 39, loaded with 286 bushel baskets of southern peaches, the special bracing held the partial third layer securely in place. This bracing consisted of a 1-by-8 across the car, nailed to 2-by-4-inch cleats that were in turn nailed to the side walls of the car. This was braced at the center by two diagonal 2-by-4's also nailed to cleats at the side of the car.

Car 40, also loaded with southern peaches, did not fare so well as Car 39. This car was heavily loaded. The partial fourth layer was braced by a 4-by-4-inch cross member nailed to 2-by-4-inch cleats at the sides of the car. This brace had been broken, and fruit from overturned and broken baskets was badly scattered about the car. Only the partial fourth layer was disarranged (Fig. 14); the rest of the load was in good order.

Car 41 was loaded with 341 bushel tubs of peaches. There was a partial third layer at each end of the car and a vacant space in this layer at the center. Cross braces of old, partially decayed lumber 1 by 8 inches in size had been nailed to 2-by-4-inch cleats in an attempt to

FIG. 14.—PARTIAL FOURTH LAYER IN CARLOAD OF PEACHES

Tho this partial layer had been braced by a 4-by-4-inch cross member nailed to cleats at the sides of the car, the brace had broken, permitting the baskets in this layer to shift out of place. (Car 40)

brace the load. Both cross braces had torn loose and the load had shifted away from one end of the car. Four baskets were crushed and several others were disarranged and tilted.

Car 42 was loaded with 426 bushel tubs of peaches. The 32 packages in the partial fourth layer had been braced by a 2-by-4 crosspiece and 2-by-4 cleats nailed to the wall. This bracing had torn loose, however, and allowed the partial layer to shift 2 feet. Eight baskets were badly wrenched.

The partial top layer is also likely to cause trouble in carloads of products shipped in crates or boxes in spite of special bracing.

Car 43, loaded with crates of cantaloupes, had three full layers and a partial fourth layer constituting five stacks at one end of the car. In

FIG. 15.—BROKEN BRACING IN PARTIAL FOURTH LAYER OF CRATES IN CAR LOADED WITH CANTALOUPES

The special bracing had been improperly placed, thus causing a strain on the center bracing which resulted in breakage of the uprights and of several crates. (Car 43)

addition to the usual bracing at the center of the car special braces of 2-by-4-inch lumber had been made for the partial layer (Fig. 15). These braces were spiked to the uprights of the center bracing about 8 inches above the top cross spreaders and the horizontal crossbars, thus making a leverage which caused the uprights to break. Ten visible crates were broken and part of the contents were spilling.

In Car 44, loaded with lugs of tomatoes, 48 lugs had been placed in a partial layer at one end of the car on top of a regular load 5 high and 6 wide. This partial layer had been braced by an oak 2-by-4 nailed to 2-by-4-inch cleats at the sides of the car. This brace had pulled out of place and allowed the partial layer to shift 4 to 8 inches. Covers of 10 of the lugs had become loose.

FIG. 16.—SHIFT DUE TO MIXED LOADING OF BASKETS AND HAMPERS

In this load of cucumbers several covers had come off and a few baskets were crushed. (Car 49)

In Car 45 the partial sixth layer had been braced in a similar manner except that the crossbar had not been nailed to the cleats and had slipped out of place, allowing that part of the load to shift.

In Car 46, with similar bracing for a partial sixth layer, one of the cleats nailed to the wall had given way, allowing the partial layer to shift 2 to 15 inches.

In Car 47 both cleats of the partial-layer bracing had been torn from their original position, with the result that 30 lugs in the partial layer had shifted 2 to 6 inches.

In Car 48 the cross brace for the partial layer was a knotty pine 2-by-4 that had broken, allowing the partial layer to shift about 15 inches and causing damage in both the partial layer and the layer below.

Mixed Load Increases Risk

Sometimes a car is loaded with two or more kinds of packages containing either the same or different commodities. If the packages

FIG. 17.—A MIXED LOAD OF TUBS AND HAMPERS

The load was badly shifted from both ends of the car. The packages of cucumbers were wrenched and their contents spilling. (Car 50)

differ materially in size or shape, loading is inconvenient and the risks of damage in transit are increased.

In Car 49, loaded with cucumbers mostly in bushel baskets and tubs except for two stacks in bushel hampers, the baskets had shifted away from the stacks of hampers about a foot, leaving the baskets tilted. The covers had come off several baskets and part of the contents had spilled. A few baskets were crushed, especially in the bottom layer near the doorway (Fig. 16).

The load of cucumbers in Car 50, in bushel tubs and hampers, was very badly shifted from both ends of the car. Many packages were tilted and disarranged with covers loose and contents spilling (Fig. 17).

Car 51, loaded with peaches in half-bushel and bushel baskets, showed both end and side shifts. Several baskets were tilted and 4 baskets near the door were spilling.

Rough Handling May Cause Shift in Best of Loads

In spite of all precautions that may be taken to load a car of perishables in the most approved manner, it sometimes happens that the car receives a bad jolt or bump that will seriously disarrange the load and cause damage to the product.

Car 52, carrying a regular end-to-end offset load of peaches in bushel tubs, showed a 1-foot shift from east to west in the top layer. Three baskets at the east end of the car were spilling, and 1 at the west end was tilted. Two baskets near the doorway had been caught in the floor rack and wrenched out of shape.

Car 53, likewise loaded with a regular end-to-end offset load of peaches in bushel tubs placed 3 high, 6 wide, and 22 long, showed a 6-inch to 2-foot shift away from the bunker in the two upper layers at the east end of the car. Two baskets were spilling at the east end of the car and four were jammed at the west end.

Car 54, with bushel baskets of apples loaded according to the end-to-end offset method, 4 high, 6 wide, and 22 long, showed a 6- to 18-inch shift at the west end and some shift also at the east end. Four baskets were spilling at the east end and 2 at the west end.

Car 55, loaded with bushel baskets of apples in the same way as the preceding car, showed a 1- to 2-foot shift in the two upper layers from each end toward the center. The packages were badly disarranged at both ends of the car and 4 baskets were spilling.

Car 56, likewise loaded with 528 bushel baskets of apples in the most approved manner, showed a 1- to 3-foot shift away from the bunker at the west end of the car. At the east end 2 baskets were crushed and spilling.

Car 57, loaded with bushel baskets of summer apples 4 high and 6 wide, according to the regular end-to-end offset method of loading, showed a 6-inch to 3-foot shift lengthwise of the car from east to west. About 20 percent of the baskets at the east end of the car were tilted and some of them had settled into the lower layers. The covers were off 3 baskets and the contents spilling. At the west end of the car 2 baskets

were crushed and 2 were without covers. A partial view of one end of the load and the appearance of the car at the doorway are shown in Fig. 18. There was evidence that the loading may have been somewhat loose, but the principal damage was undoubtedly due to rough handling.

Car 58, loaded with peaches in half-bushel baskets, showed a 1- to 2-foot shift in the two top layers at the west end. Several baskets at that end of the car were disarranged and tilted and the contents of 6 baskets were spilling. At the east end of the car 8 baskets in the top layer were jammed and crushed. The general condition of the load is shown in Fig. 18. The unloader's report showed 20 baskets wrenched, 17 baskets with faces broken, and 2 baskets left empty in the car. The

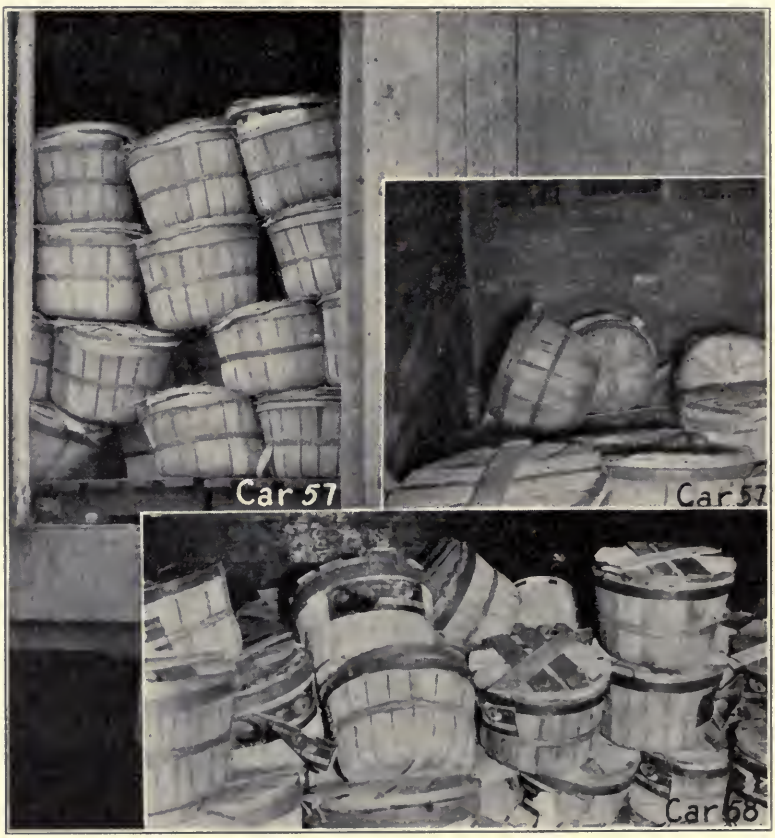

FIG. 18.—LOADS DISARRANGED BY ROUGH HANDLING

In Car 57, loaded with bushel baskets of summer apples, part of the baskets in the lower layer were wrenched out of shape. This was an end-to-end offset load, but had been roughly handled. In Car 58, loaded with half-bushel baskets of peaches, 20 baskets were wrenched out of shape as a result of rough handling.

damage in this car appeared to be due to rough handling rather than loose loading.

Car 59, loaded with cucumbers in bushel tubs 3 high and 6 wide according to the end-to-end offset method, showed a 7-foot shift in the top layer and a 2-foot shift in the bottom layer. Several packages were broken and their contents had spilled on the floor. The report on the salvaging of this load included the following statement: "50 contents bruised and partly crushed; 75 contents smashed and jammed (contents 15 percent damaged); 97 repacked okeh; 37 taken *as is* (contents of these 15 to 20 percent slightly bruised)."

FIG. 19.—THE RESULT OF A SEVERE JOLT

The center bracing in this car of cantaloupes was broken, and one crate displaced from the top layer had dropped to the floor. Five crates in the top layer were broken and the contents partly spilled. (Car 60)

In Car 60, loaded with jumbo crates of cantaloupes 3 high and 6 wide, the center bracing was badly broken and one crate had dropped from the top layer to the floor (Fig. 19). Five crates in the top layer next to the broken gate had the ends shoved in, slats broken, and contents partly spilled; 4 crates in the middle layer were also badly buckled, owing to the broken parts of the gate having been punched into the ends of the crates.

Car 61, loaded with tomatoes in 30-pound lug boxes, arrived in good condition and one small truck load was taken out. The car then remained in the yards two days before unloading was resumed. Considerable switching was done in the meantime, and the car evidently received rather rough handling, for the load had shifted from both ends toward the center. Several lugs showed covers loose or broken. The shift also caused extra weight on centers of some packages, crushing contents.

Car 62, loaded with lugs of Tennessee tomatoes 5 high and 6 wide and braced in the usual manner, was equipped with "banana racks."[1] The entire load, including these floor racks, had shifted 6 to 8 inches from the *A* toward the *B* end of the car, causing three layers of crates at the *B* end to be badly crushed, buckled, and disarranged. The contents of several crates were spilling. There was also a 4-inch shift in the top layer at the doorway. This disarrangement of the load occurred in spite of the fact that the center bracing held. In salvaging this load 79 lugs were renailed and 73 broken lugs were recoopered. In 23 of these, part of the contents had been picked from the car floor. Four lugs were left empty in the car; some of the contents of these had been used in repacking. Some crushed and bruised tomatoes were left on the car floor as worthless.

In the instances just mentioned the damage to the respective loads was undoubtedly due primarily to rough handling of the cars between the time they were loaded and the time they were unloaded.

HANDLING A DISARRANGED LOAD TO PREVENT FURTHER DAMAGE

Reference has been made to the salvaging of disarranged loads. Adequate provision has been made for taking care of such work at the Chicago Produce Terminal. In fact, there is a regular force of coopers constantly on duty in the team track yards for the purpose of repairing broken packages and repacking spilled products. Even if the damage in a given car consists only of a few loosened slats on a crate or one crushed basket, a cooper is on hand to make the needed repairs. In the ordinary process of unloading a car the unloader sets aside any packages that may need repairing; and when the unloading is nearly completed, the cooper gets into the car and gives attention to such packages in time for them to be taken with the last truck load.

In a car where there is considerable damage two coopers work right along with the unloaders and repair the broken packages as they are reached in the unloading. If the broken packages are at the doorway, they are carefully moved to the truck backed up to the door, and repaired on the truck. As soon as there is enough space for them to work in the car, the coopers transfer their operations to the car and continue until they have repaired all the broken packages or repacked their contents into new packages. Even badly broken slatted crates can be recoopered by supplying new parts, but badly broken baskets have to be exchanged for new ones. Each cooper carries with him a supply of slats of the sizes likely to be needed, and a supply of baskets is kept at a convenient place in the team track yard.

[1] "Banana racks" are temporary floor racks not attached to the car.

The thoroness, care, and efficiency with which the coopers do their work and the cooperation they receive from the unloaders greatly reduce the losses that might easily occur in the case of disarranged and damaged loads. Even a load as badly disarranged as that in cantaloupe car No. 27, already mentioned (page 94), was delivered to the owner with a shortage of only 4 melons from one crate. However, a total of 39 crates had been repaired and 12 renailed. Of the repaired crates 8 had been repacked.

The load in cantaloupe car No. 60, a view of which is shown in Fig. 19 as it appeared when the car was first opened, was put in condition for reshipment by the coopers. The broken crates were repaired and the center bracing rebuilt. The only shortage recorded was 21 melons lacking from one crate.

The cost of the cooperage service is included in the charge for inspection on the basis of a flat rate per car for all commodities, regardless of the amount of coopering needed. Three different inspection bureaus serve the various railroads using this terminal yard, each having a contract to do the work for certain railroads. In addition, one railroad maintains its own inspection and cooperage service.

PRECAUTIONS TO PREVENT DAMAGE BY SHIFTING OF LOAD

A load of perishables packed in baskets or crates is much less likely to suffer damage in the normal process of transportation if the packages are properly stowed and the load properly braced. There are recognized standard methods of loading each kind of package, and definite loading rules have been adopted by the railroads serving certain territories.[1]

End-to-End Offset Load for Baskets

The end-to-end offset load is recognized as the approved method of loading bushel baskets of Illinois products. Most of the refrigerator cars usually available to Illinois shippers are of such dimensions that a good tight load can be secured by placing 22 baskets in each row lengthwise of the car. Each basket in each row and each layer breaks joint with each adjacent basket. Arranged in this way the load is 6 baskets wide. Baskets of peaches are loaded 3 high, making 396 to the car, and baskets of apples 4 high, making 528 to the car.

[1]For example, the tariff entitled "Specifications of Standard Containers for Fresh Fruits and Vegetables and Loading Rules No. 6," issued February 17, 1930, by E. H. Dulaney, agent for 265 railroad and steamship companies, is applicable to Southern Territory. There are also various supplements to this tariff.

To place the above number of baskets in the car, according to the arrangement mentioned, it is necessary to stow every basket tightly against its neighbors. An inexperienced loader sometimes stows the baskets so loosely in the first four rows that there is not sufficient space left at the side of the car for the last two rows. In such a case two courses are possible: (1) to reload the entire car; (2) to put as many baskets as possible in the space remaining, even tho they have to be staggered with considerable space between baskets lengthwise of the row. The only safe procedure is to reload the car; for unoccupied

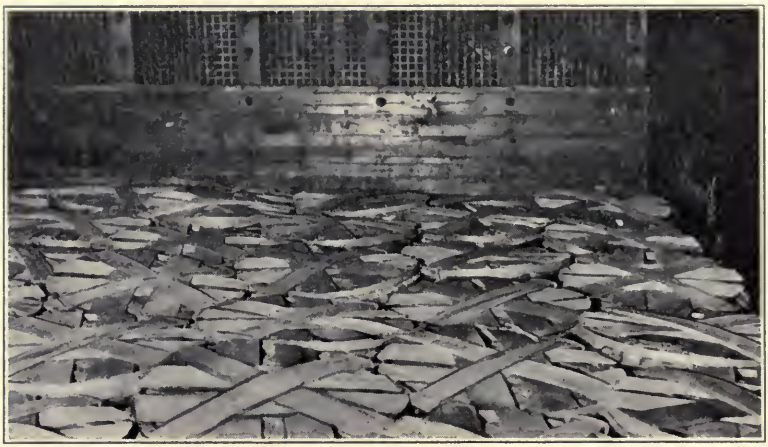

FIG. 20.—A PERFECT LOAD OF SUMMER APPLES IN BUSHEL BASKETS
This car was loaded 4 high, 6 wide, and 22 long, according to the end-to-end offset method. (Car 63)

space between baskets in the last two rows greatly increases the danger of a shift in the load and may result in considerable damage that might have been avoided if the car had been loaded properly (see Car 63, Fig. 20).

One serious difficulty encountered in the shipping of peaches in round-bottom half-bushel baskets or half-bushel tubs is that these packages are not of the right dimensions to be loaded according to the end-to-end offset method. In refrigerator cars of normal width there is not sufficient space for the last two rows, and improper stowage of the baskets in these two rows cannot be avoided. Only extra wide cars can be properly loaded with these packages according to the end-to-end offset method of loading.

The half-bushel basket is not in general use for carlot shipments from Illinois producing regions, and should not be adopted until some

change is made in its dimensions so that it can be properly loaded. Loading crosswise of the car usually results in loose loading and leaves conditions favorable for a shifting of the load.

Alternating Hampers

Illinois products that may be shipped in bushel hampers include sweet potatoes, string beans, and peppers. Bushel hampers, like bushel baskets, are loaded tightly against one another; but in the case of

FIG. 21.—A COMPACT LOAD OF PEPPERS IN BUSHEL HAMPERS

With the hampers properly stowed 7 wide and 4 high this load arrived in ideal condition even tho the packages were slightly tilted. The top layer extends considerably above the top of the door. (Car 64)

hampers the load is made still tighter by alternating the hampers that are placed right side up with others that are placed upside down. By loading the hampers in this manner 4 high and 7 wide, a compact load can be secured (see Car 64, Fig. 21). The tighter the load of hampers the better it is likely to carry.

Hooks on Baskets

Loose covers on baskets and hampers are a common cause of spilling of the contents. Packages in a load may become disarranged and tilted, but if the covers stay on, the contents will not be spilled unless

the packages are badly crushed. Wire hooks on bushel baskets and tubs are a great aid to keeping the covers in place.

Notes were taken on 118 cars of peaches and apples in bushel baskets and tubs received at the Chicago Produce Terminal between July 7 and 31, 1931. Of these, 60 had wire hooks on the covers and 58 were without hooks. In only 13 of the cars with hooked basket covers were there any visible baskets with contents spilling. On the other hand, 31 of the 58 cars loaded with baskets without hooked covers showed baskets with contents spilling. Furthermore, in the cars containing baskets without hooks the number of baskets with contents spilling was usually greater than in the cars with hooks. Hooks on covers not only tend to keep the contents in the baskets but also hold the covers rigidly in place and tend to prevent bruising of the contents.

Use of Pads in Baskets

The bruising of peaches and summer apples in bushel containers can be further reduced by the use of excelsior pads under the covers in place of the usual corrugated paper pads. A few cars of peaches observed at the Chicago Produce Terminal in July, 1931, were packed in this way and were notably free from package bruises.

The use of corrugated or excelsior pads in the bottoms of bushel tubs would be an additional precaution to prevent bruising of fruit shipped in these containers, tho it is possible that the additional padding might have some undesirable effect on the refrigeration of the product. Tests would need to be made to determine this point.

Careful Stripping of Rectangular Packages

Illinois products normally packed for shipment in rectangular crates include tomatoes, muskmelons, and strawberries.

As shipped from most important producing regions, these commodities are loaded with continuous air spaces between the rows of crates lengthwise of the car; and provision is made to prevent the crates from shifting sidewise and closing these spaces, by the use of strips on top of each layer of crates in every stack. Proper loading of small crates particularly, includes *nailing* two strips to every package in the car. One strip is butted against one side wall of the car and the other strip against the opposite wall. If the strips are not nailed, they are less effective in preventing a shift in the load.

Various sizes of strips are used. Altho the loading rules applicable to Southern Territory call for strips not less than ½ by 1¼ inches for the loading of tomatoes packed in lug boxes, the strips actually used

TABLE 1.—DIMENSIONS OF STRIPS IN TOMATO CARS OBSERVED AT CHICAGO PRODUCE TERMINAL, JULY, 1931

Dimensions	Cars	Dimensions	Cars	Dimensions	Cars
¼" x 1"	1	⅝" x 1"	1	1" x 1"	3
⅓" x 1"	11	⅝" x 1¼"	2	1" x 1¼"	1
1½" x 1⅜"	2	¾" x ¾"	4	1" x 1½"	3
1½" x 1¼"	16	¾" x 1"	1	½" x ¾" to 1¼"	1
1½" x 1½"	1	¾" x 1¼"	4	½" x ¾" to 1½"	1
½" x 2"	1	¾" x 1½"	3	Total—	56

in cars of tomatoes that were observed at the Chicago Produce Terminal during July, 1931, varied from ¼ by 1 inch to 1 by 1½ inches with all sorts of intermediate dimensions (Table 1). In 23 of the 56 cars of tomatoes on which notes were taken regarding the shipping, the strips were less than 1¼ inches wide. When narrow strips are used, there is greater danger of the lug boxes slipping off the strips in case of a slight endwise shift in the load. Small square strips (¾ by ¾ inch or 1 by 1 inch) are especially undesirable since they are likely to roll and let down the upper layers of lugs unless very securely nailed. The bad conditions in Car 33 already mentioned (page 97) were doubtless accentuated by the use of ¾-by-¾-inch stripping. Double stripping to increase the space between layers of lugs packed with a large bulge is also very undesirable, since such stripping does not readily retain its position in the load and the very object of the extra stripping is defeated in case of a slight end shift. The lugs easily shift off the strip and tend to crush the contents of those below. Car 65, double-stripped with ¾-by-1¼-inch stripping, had several lugs slipped off the strips. In Car 66, double-stripped with ⅝-by-1¼-inch stripping, the second, third, fourth, and fifth layers of tomato lugs in 5 stacks at one end of the car had slipped off the stripping.

FIG. 22.—INADEQUATE STRIPPING OF LOAD OF CANTALOUPES
Here the stripping was insufficient to protect the contents of the lower packages from bruising. (Car 67)

Cars of cantaloupes from the West are usually very carefully stripped. Occasionally, however, the strips are not thick enough to

offset an extra large bulge in the crates made by a heavy pack, and sometimes not all the layers are stripped. Such was the situation in Car 67 (Fig. 22). Altho the load carried without any apparent shift, conditions were favorable for bruising of the melons, since the weight of the upper layers of crates rested directly on the melons below instead of on the strips across the ends of the crates.

Adequate Center Bracing

The approved method of loading cars of tomatoes, cantaloupes, and various other products packed in rectangular crates includes adequate bracing at the center of the car. For this purpose two gates are used, and these are braced apart by spreaders.

For bracing the center of the load in cars of tomatoes packed in 30-pound lug boxes, loaded 5 high and 6 wide, each gate consists of three 2-by-4-inch crosspieces (the bottom one resting on the floor rack, the middle one opposite the third layer of lug boxes, and the top one opposite the top layer of lugs) and six 1-by-4-inch uprights (one opposite each row of crates). The uprights are next to the crates. The second and fifth uprights extend to the top of the car, and have a cap piece at the top to prevent the upright from being pushed thru the ceiling of the car. Cross spreaders of 2-by-4-inch material brace the gates apart. Three sets of these spreaders are used: one set at the bottom in contact with the floor rack, one set opposite the top crosspieces of the gates, and one set opposite the center crosspieces of the gates. Usually there were 4 spreaders in each set, making a total of 12 spreaders in the bracing for a tomato car.

In the cars of tomatoes received from the principal shipping region during July, 1931, the center bracing consisted mostly of seasoned oak lumber. Sometimes the uprights as well as the crosspieces consisted of 2-by-4's. This type of oak bracing holds the load very securely under normal handling conditions.

Sometimes the top crosspiece was placed above the top of the top layer of crates, as in Car 68 (Fig. 23). This arrangement rendered the bracing less effective, tho with oak lumber it usually held.

The lack of proper center bracing in cars of tomatoes, evidently from new producing regions, was an important cause of arrival in bad order (see Car 37 and Car 38, Fig. 13, page 99).

Cars of cantaloupes packed in standard or jumbo crates, observed in this study, were usually braced at the center of the load with pine lumber, each gate consisting of four 2-by-4-inch uprights and three 1-by-4-inch crosspieces, tho in some cars the crosspieces also were of 2-by-4-inch material. The crosspieces were next to the crates. In

the most effective bracing there were three sets of cross spreaders between the gates: one at the bottom next to the floor rack, one at the top, and one at the center. A change in the position of the spreaders, or the omission of one set of spreaders, greatly weakened the bracing.

FIG. 23.—A WELL-BRACED TOMATO CAR

Except that the top crosspiece is slightly too high, this car shows regulation bracing. Nearly all the cars with oak bracing of this type arrived without a shift in the load. (Car 68)

Improperly made bracing was evidently a contributory cause to the breakage in cantaloupe car No. 26 (Fig. 9). In Car 28, loaded with standard crates of cantaloupes 3 high and 7 wide, there were only two sets of spreaders—one opposite the center of the bottom layer of crates and the other opposite the center of the top layer. Three sets of spreaders, properly placed, might have prevented the collapse of the bracing.

The lumber used in the bracing of several cars of cantaloupes was knotty and brashy. Better lumber would doubtless have improved the effectiveness of the bracing.

The distance between the gates at the center of the car, and hence the length of the spreaders, depends on the arrangement of the load as to number of packages in each row, tightness of the load, and length of the car. In eleven cars of tomatoes with the lug boxes loaded 21

long, the length of the center bracing varied from 23½ to 29 inches, a range of 5½ inches. In eight cars loaded 20 long, the center bracing varied from 39 to 46½ inches, a range of 7½ inches. In two cars loaded 19 long, the length of the bracing was 54½ inches and 62¼ inches respectively. Some of the cars were loaded more loosely than they should have been for safety in carriage. Car 66, for example, with bracing only 23½ inches long, was too loose a load. This condition, combined with double stripping, allowed many of the lugs to slip off the strips. Car 69, with 29-inch bracing, showed no shift whatever and no broken or damaged packages.

Unless the packages are stowed tightly against one another in the row lengthwise of the car as they are loaded, the load is likely to be loose in spite of attempts to make it tight by forcing long spreaders into place at the center of the car after all the packages have been loaded. The spreaders have to be cut especially for each load and should usually be not more than an inch or two longer than the space between the gates when the latter are in position tight against the load. They are driven into position and nailed.

While Illinois tomatoes, muskmelons, and other horticultural products normally packed in rectangular containers are usually not shipped as great distances as similar products from some other producing regions, and hence might presumably be exposed to less risk of damage during transit, it is unwise to assume that such products will arrive safely at the terminal markets without careful loading.

Use of Well-Made, Rigid Containers

The straight-sided or tub bushel is a more rigid container than the round-bottom bushel basket, and hence is less easily crushed in the bottom layer of a load by the weight of the layers above when the load is riding smoothly. In case of a shift in the load, however, the bottoms of the tub bushels in the lower layer are more likely than the round-bottom baskets to be caught in the floor rack and the packages wrenched out of shape.

As observed at the Chicago Produce Terminal in July, 1931, the tub bushel predominated over the round-bottom bushel basket as a shipping container for peaches but not for summer apples. Seventy-seven percent of the peaches in bushel containers were in tubs, but only 12 percent of the apples were in tubs. This difference was probably due largely to the fact that the two commodities were being shipped principally from different producing regions rather than to the selection of the more rigid package for the peaches in the same region. An additional reason for using the round-bottom (lower-

priced) package for the apples may have been the extremely low price of apples prevailing at the time.

Some tubs and round-bottom baskets are more rigid than others by reason of their being made of thicker veneer, or having more or heavier hoops, or being more securely stapled. Well-made packages of either type are safer shipping containers than poorly made or flimsy packages. Specifications for standard containers, as recognized by the railroads, are included in the tariffs along with the loading rules.

Very often the damage to a load of products packed in lug boxes or slatted crates consists principally of loosened slats or covers, in which case the damage may be more apparent than real but nevertheless disconcerting and requiring considerable cooperage service. The use of cement-coated nails in the make-up of crates and boxes tends to make the slats pull off less easily. Cement-coated nails are especially desirable for nailing up crates for the packing of products that are to be loaded with top icing, such as green corn, lettuce, and cauliflower, since the moisture from melting ice softens wood and makes ordinary nails pull out easily.

Demonstrations in Proper Loading

In many localities where the shipping of perishables is a new industry, faulty loading is due to lack of knowledge rather than wilful carelessness. Printed instructions and diagrams giving details of the proper methods of loading various commodities are included in the tariffs already mentioned (see footnote on page 107) and are presumably available at all shipping points handling the given commodities. It is difficult, however, for many people, to get an adequate conception of proper loading from the reading of printed directions or looking at diagrams. Proper loading could be brought into common use much more quickly in new regions if the perishable freight department of each railroad would assign a skilful loader to give demonstrations in proper loading at the beginning of the shipping season in each important producing region. All persons to be employed in the loading of cars of the given perishable should be requested to attend such demonstrations and to receive any other instruction that might seem desirable. Time spent in the instruction of loaders would doubtless be fully justified by the safer carriage of the products resulting from better loading.

Careful Handling of Car

Even when well-made packages and proper methods of loading and bracing have been used by shippers, there sometimes occurs a shift

in the load and consequent damage to the product. This may result from rough handling. A severe jolt to a car in transit may at times be unavoidable, but in other cases it may be due to carelessness in switching or handling the car. The urgent demand by shippers for fast train schedules sometimes results in safety being sacrificed for speed. A continuous safety-first campaign in reference to perishable freight would no doubt be beneficial to many railroads as well as to shippers and receivers.

OTHER PRECAUTIONS TO REDUCE DETERIORATION IN TRANSIT

In spite of careful handling in harvesting and packing, prompt loading, and precautions to prevent shifting of the load, certain perishable products sometimes fail to reach the market in acceptable condition on account of deterioration or decay before delivery. This is sometimes due to the shipment of a product of poor carrying quality, failure to ship under refrigeration, or failure to unload promptly.

Prompt Movement of Perishables

Much deterioration in the condition and value of perishables sometimes takes place after the car is received in the terminal market, especially when unloading and movement into consumption are delayed for several days pending a hoped-for improvement in market conditions.

Data secured at the Chicago Produce Terminal in July, 1931, on particular cars observed mainly for other purposes show that in some cases several days elapsed from the time the cars were received until they were unloaded (Table 2). In some instances the delayed unloading was associated with off-condition of the product.

In general, prompt unloading and rapid movement into consumption are highly desirable in the marketing of perishable products.

TABLE 2.—TIME OF UNLOADING 112 CARS OF PERISHABLES AT CHICAGO PRODUCE TERMINAL, JULY, 1931

Commodity	Total cars observed	Number of cars unloaded on day indicated							
		1st day	2d day	3d day	4th day	5th day	6th day	7th day	8th day
Cantaloupes	11	4	3	2	1	1	..	..	..
Peppers	7	3	2	1	1	..	..	..	..
Cucumbers	13	11	1	1	..	..	..	..	..
Summer apples	18	8	5	2	3	..	..	..	..
Peaches	47	32	8	4	2	1	..	..	..
Sweet potatoes	2	1	1	..	..	..	..	..	..
Green corn	8	5	1	..	..	..	1	..	1
Lettuce	6	2	..	3	..	1	..	..	..
Total	112	66	21	13	7	3	1	0	1

Elimination of Poor Shipping Varieties

The producer has a responsibility to himself, to the carrier, to the trade, and to the consumer in reference to the varieties of fruits he produces and ships. Varieties of poor carrying quality have little place in long-distance shipments under modern trade conditions. There are many varieties suitable for home use or local market that are too tender and perishable to compete favorably in the wholesale market with varieties of better carrying quality. Varieties of good carrying quality are much surer to arrive in terminal markets in acceptable condition than those of poor carrying quality. Most of the decayed peaches observed at the Chicago Produce Terminal during these studies were of one variety—a tender-fleshed sort that did not have good carrying quality.

It is a serious mistake to increase the hazards of shipment by using a tender variety when there are better shipping varieties of the same kind of product. The physical condition of the product on the market is more important in determining its market value than its eating quality at the time it is packed. Considerable "grief" could be avoided if only varieties of good shipping quality were shipped.

Consistent Use of Refrigeration

Some commodities are shipped under refrigeration in hot weather and over long distances, and under ventilation in cool weather or over short distances.

When market conditions are unfavorable owing to an abundance of a given product, there is always a tendency to risk shipments without refrigeration in order to reduce transportation expense, even tho the weather is likely to be hot before the shipment reaches destination. Under such circumstances the risk may be greater than contemplated, for the temperature may go higher than anticipated, and the very market conditions that made reduced transportation expense seem advisable are likely to result in delayed unloading and further deterioration of the product. If the market price of a perishable product usually shipped under refrigeration at a given season does not warrant the expense of refrigeration, it is a question whether it is wise to ship the product at all.

An attempt to salvage early potatoes from Texas that had been shipped without refrigeration because the price was low was observed at the Chicago Produce Terminal. The net result was a lot of disagreeable work, considerable loss to the railroad company, and no return whatever to the shipper.

SUMMARY AND CONCLUSIONS

1. Observations were made on 249 carloads of fruits and vegetables at the Chicago Produce Terminal in the summer of 1931, with a view to determining the causes of damage to such products during shipment.

2. The chief immediate cause of damage was found to be shifting of the loads. This was true of various commodities shipped in various types of packages.

3. Shifts in load were due primarily to two causes—faulty loading and rough handling of the car.

4. Faulty loading of bushel baskets, tub bushels, half-bushel baskets, and bushel hampers usually consisted of failure to stow the packages in a sufficiently compact arrangement to make a rigid load.

5. Faulty loading of slatted crates and other rectangular packages consisted chiefly of inefficient stripping of the load (either failure to use strips at all, the use of strips that were too narrow, the improper placing of strips, or failure to nail them); failure to stow the packages rigidly against one another in each row lengthwise of the car; or inadequate center bracing.

6. An incomplete layer of packages at the top of the load was always a menace to safe carriage of the product.

7. The loading of different kinds or sizes of packages in the same car increases the difficulty of loading and is likely to result in a disarranged load.

8. Rough handling of a car in transit or in the switch yards may result in serious shifting of the load and severe damage to the product in spite of all precautions that may have been taken to load the car properly.

9. A combination of proper loading and careful handling would result in the delivery of a very high percentage of the cars of perishables at their destinations without any appreciable shift in the load.

10. The use of well-made packages with securely fastened covers would still further insure the safe carriage of perishable products.

11. Improper loading, especially at new shipping points, is due primarily to lack of knowledge as to what constitutes proper loading. Altho printed specifications of definite, recognized, standard methods of loading cars with various commodities are available, they need to be supplemented by demonstrations in actual loading and even by schools of instruction at new shipping points.

12. A safety-first campaign in reference to perishables should be in continuous operation on every railroad.

13. If the above suggestions were put into operation all over the

country, it would be possible to cut in half the present loss because of damage to perishables during shipment.

14. Efficient as is the present cooperage system of salvaging the products in disarranged loads at the Chicago Produce Terminal, the amount of such service needed could be greatly reduced by proper loading and careful handling of cars. Reduction in this service would mean a reduction in expenses connected with the handling of products at the railway terminal.

15. Losses could be still further reduced by shipping only products with good carrying quality, by the consistent use of refrigeration in seasons and over distances ordinarily requiring it, and by prompt unloading of cars upon their arrival.

UNIVERSITY OF ILLINOIS-URBANA
Q.630.7IL6B C002
BULLETIN. URBANA
377-389 1932-33
3 0112 019529228